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SOUTHWEST REGION

FOREST RESOURCES

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RESOURCE PLANNING TEAM

RESOURCES INVENTORY

SOUTHWEST REGION

FORESTRY RESOURCES

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Joint Federal-State Land Use Planning Commission

March 1974

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THE FOREST RESOURCES OF THE SOUTHWEST REGION

The forest zones of the Southwest Region extend from the geographical center of Alaska to the southernmost limit of the interior forests types near Lake Brooks (Katmai National Monument). From a resource management standpoint, the region is subdivided into three subregions which are natural hydrologic basins. Two of the subregions, the Kuskokwim and the Bristol Bay are separated by the Kuskokwim Mountains and are drained by the Kuskokwim River and its major tirbutaries in the Kuskokwim Bay subregion and the Mulchatna/Nushagak, and the Naknek River drainages in the Bristol Bay subregion. The Aleutian Islands subregion starts at a line across the narrow neck of land between Port Moller and Stepovak Bay.

This report will be divided into these three subregions with discussions and data presented separately on the forest ecosystems for each system.

The Kuskokwim and the Bristol Bay subregions have the same three interior forest ecosystems. The lowland spruce/hardwood type is characterized by relatively flat lowland areas, and northern exposures are usually poorly drained, swampy, underlain with peat and permafrost and occasionally burned over. Black spruce is the dominant tree species. It is found in dense patches or scattered trees. Maximum tree size would be six inches in diameter and 40 feet in height. The

average tree diameter would be three inches with average heights ranging from 10-20 feet. This forest type also contains some birch and aspen, usually stunted, on better sites which are still marginal for tree production.

Larch is found in the black spruce environment, and usually occupies the poorest forest sites. Larch grows well on good sites, but it is out-competed by the other spruce species, so it is relegated a niche in the environment where other trees can no longer compete or can just barely exist.

These lowland forests could be considered nonmerchantable or non-commercial primarily because of slow growth, small size, inaccessibility, and inefficiency of harvesting. The trees of this ecosystem could be used for firewood or whatever subsistence use could be used for firewood or whatever subsistence use could be made of the wood. The possibility of using the wood for chips or pulp exists, but the desire or need for such use has not been expressed for Alaska yet. Generally these forests are inaccessible unless the land area is transected by rivers or future development of transportation corridors.

The second forest ecosystem is the upland/hardwood white spruce type composed primarily of birch and aspen with scattered stands and individual white spruce trees. Some balsam poplar is also found as well as scattered patches of black spruce. The type contains commercial and noncommercial trees and stands depending on the site. Site includes

such factors as soil type, elevation, aspect, slope, and drainage. On the better sites, relatively rapid growth rates produce trees up to about 70 foot heights and 14 inch diameters. These sites are generally too far removed from access points on rivers or lakes to be of any economic value at the present time, but the fact that this ecosystem contains sites capable of producing merchantable timber is important. They are storehouses for possible future timber harvesting when and if the need for birch, aspen and white spruce arises or transportation development makes the commercial stands accessible.

The third forest ecosystem is the bottom land spruce/poplar forest. It is found on well-drained soils on river terraces, along river banks and more recently abandoned river channels. The type can be highly commercial, supporting the largest, most vigorous white spruce and poplar. It is easily accessible and products are readily transported via river or lake travel.

The forest ecosystem range appears to be defined and limited by climatic factors. The forests of the Bristol Bay and Kuskokwim Bay subregions are located within the transitional climatic zone and some of the Upper Kuskokwim falls in the continental climatic zone (Environmental Atlas). The continental climatic zone is characterized by greater temperature fluctuations with warm summers, cold winters, and considerably less precipitation than the maritime climatic zone. Hopkins (Environmental Atlas) states that generally trees are found where there are enough

warm days in the summer months so that the sum of the difference between the daily mean temperatures over 50° F and 50° F total 130 degree days. The degree day criterion is used to draw the overall dividing line between forested zones and tundra based on summer warmth. At forested measuring stations, those areas with mean temperatures of 15° F or higher for the coldest month have dense forests while areas with means below 15° F have moderate or sparse subarctic forests. By that criterion Bethel and much of western Alaska, the Alaska Peninsula, and Aleutian Islands should be forested, yet only a few scattered truncated spruce are found around Bethel, and those trees look more like large erect shrubs. Since a seed source is present in the river valleys and soil type and temperature factors appear to allow the establishment of a few trees in areas near Bethel, the wind could be a major factor preventing establishment of forests and the south and westward expansion of the forest zone. Ground condition could also be a factor affecting tree establishment. Exposed mineral soil, even in permafrost zones, should allow seed germination and scattered spruce trees are occasionally seen in permafrost areas even where no soil is exposed indicating that bare soil is not always necessary for seed germination and that permafrost does not prevent tree establishment. Winds in the right season could prevent the seed from scattering into new areas or could destroy seedlings because of the chill factor, abrasion by wind borne particles or stern breakage by the wind's pressure, and desiccation of the plant where water evaporates from the plant faster than it can be absorbed by the roots.

The forests of the region have traditionally supplied local residents with building materials and fuel for home heating and powering steam machinery, decorative materials such as bark, tools, weapon handles, and utensils. The forests are an important factor in game habitat. The establishment of the fisheries industry and various mineral prospecting and extraction activities did not create a demand for timber or forest products harvested in the region as would be expected. Most, if not all, of the construction material was imported. Some construction did utilize local spruce in the mining areas for cabins and other buildings, bridges, and some mining timbers. Presently some recreation cabins and lodges are being constructed and heated with local timber.

KUSKOKWIM BAY SUBREGION

FOREST ECOSYSTEM MAP REFERENCE

The three forest ecosystems of the subregion are identified on the map at the end of the narrative. Two maps exist depicting the forest and other vegetative types. One map is the U.S. Geological Survey Series E Map at 1:2,500,000 scale and the other is a USGS 1:250,000 scale topography map which is still a broad indicator of vegetative cover.

The forest have been subdivided into four major categories based on representative tree species composition and location of type, not by commerciability, access, or economic considerations. The forest ecosystem maps delineate the forest and vegetative types by color, pattern or number on the various maps.

On the Series E map, the number two type - bottom land spruce/poplar type - is indicated by the solid dark green. The type occupies the Kuskokwim River flood plain and river terraces or benches roughly from Lake Minchumina to Sleetmute with a major forest zone hiatus downstream to Napamute. The heavily forested zone continues from Napamute to near Tuluksak.

Major tributaries lined with the bottom land spruce/poplar forest type are the South Fork of the Kuskokwim, Big, Nixon, Swift, Stony, Hoholitna, Holitna, and Aniak Rivers. Small streams also have very narrow strips of this forest type labeled number two on the maps occupying about 1,581,000 acres.

The upland spruce/hardwood ecosystem is the brushed areas on the map; it is labeled number three. It is the major forest land acreage in the subregion covering 9,293,000 acres and is found primarily west of the upper and middle Kuskokwim River. Large areas of this type are also found south and west of the river in the Lime Hills area. The lower river areas are surrounded by timber and muskeg.

The number four type forest type is the lowland spruce/hardwood type found primarily to the east of the Kuskokwim River. Large acreages of this type are also found integrated into the number three type. The two can generally be separated along elevation contour lines on a map with the number 4 (lowland) type generally occupying the lower elevations and northerly exposures and the number 3 (upland) types occupying the upper elevations as the titles suggest. This ecosystem covers 3,385,000 acres.

FOREST LAND STATUS

It appears that the most productive timber lands of the Kuskokwim Bay subregion, the bottom land spruce/poplar type, will be in Native regional and village corporation control, especially along the major rivers. The upland and lowland timber types south of the Kuskokwim River and some fairly productive bottom land forests along major tributaries of the Kuskokwim and the hills west of the Alaska Range will probably be in state control. Some 31 lands roughly between Stony River and Nikolai have upland and bottom land forests and will

probably remain in Federal control including a portion of the relatively high timber production zone along the Kuskokwim River upstream from Stony River. Some of the upland forest lands near Cairn Mountain south of the Stony River and another areas south of Sleetmute are open to homesteading and other forms of land entry.

The major timber production lands and forested lands generally are located nearby on a 50/50 basis in Calista Regional Corporation and Doyon Limited lands. A small area on the eastern end of the Kuskokwim Subregion is within the Cook Inlet Region Corporation boundary, and some upland forests in the Taylor Mountains vicinity are included within the Bristol Bay Regional Corporation boundary.

ACCESS AND TRANSPORTATION

Access and transportation are via three methods:

1. Aircraft, including helicopter and balloon (landing either on air strips, snow, or open water).
2. Overland via all terrain vehicles in all seasons or by road.
3. Boat travel on either river or lakes.

Various types of aircraft could be used to put people into any of the forest zones and transport forest products out of the harvest or processing area if the timber is needed and other forms of transportation are infeasible. Air access to remote lakes and streams, and

wheeled and ski equipped aircraft landings on areas free of vegetation is possible. Winter use of aircraft fitted with skis in place of floats or wheels could provide access to otherwise remote and inaccessible forests primarily the upland spruce/hardwood type to put in field crews or remove forest products.

Helicopters, balloons, and various aerial tramways have been used to transport logs from the woods in many areas. They could also be used to ferry processing machinery into the harvesting area and transport out finished products.

Overland access and transportation would be via various all terrain vehicles over the frozen surface in winter months or via the few roads which connect villages or which connect a resource development area to another transportation transfer station. Such roads are Sterling Landing on the Kuskokwim River inland to Ophir and Kalskag to Lower Kalskag or any of the recently proposed surface transportation routes in the 20 year highway plan.

Boat access and transportation is the most practical method of transportation. The bottom land spruce/poplar forests are located in the flood plain and along the banks of all the larger rivers and extend back from the river and slough banks up to about one mile. Because of the great number of side sloughs, oxbows and old channels, logging activities and product transportation would be more complicated. Camps would have

to be moved often as the resource is basically a ribbon of trees along the river banks. The upland timber types would probably be inaccessible to river transportation because of excessive distance from the streams, but certain upland forests have relatively easy access from some lakes.

Economic analysis would have to be conducted to evaluate all transportation methods considering values and uses of the final products, market location, utilization, cost of substitute products such as synthetics, aluminum, and importation of similar wood products from some other area.

GENERAL FOREST USES

From a recreation, aesthetic or scenic aspect, the forests in the Kuskokwim Bay Subregion are usually viewed from an airplane or river boat. They enhance the general vast, distant, and open vista and offer color and texture variety. Most of the recreation in the subregion is in conjunction with hunting and fishing.

Most hunting and fishing is for subsistence purposes by local residents with a little sport hunting and fishing by locals and tourists including other Alaskans. The potential for developing a sizeable tourist industry appears remote in the near future unless historic mining areas like Iditarod are developed or river excursions are inaugurated which will attract tourists.

The forests are, of course, a major factor in wildlife habitat and watershed protection and the management considerations pertaining to forest manipulation should evaluate the impacts on game habitat and watershed stability.

The bottom land forest ecosystem is generally also indicative of the better soils and growing conditions for home gardens or some limited agricultural use, although no commercial agricultural ventures have been reported. No grazing of domesticated range animals other than reindeer is associated with any of the forest ecosystems in this region.

Subsistence use on forested lands consisted of gathering berries, roots, and other vegetation, hunting, fishing, some trapping, and using actual forest products for home construction, heating, boat building, and making tools and weapons, vessels and clothing.

Mineral activity in the region has been widespread from a prospecting and claim staking standpoint, but little development on a large scale has occurred; however, the potential for mineral development does exist within the forest ecosystems. The major mineral occurrences in the Kuskokwim Bay Subregion appears to be in the Taylor Mountains with promising mineral occurrences in the Kuskokwim River Valley, especially near Medfra, Sterling, and Sleetmute, west of Rainy Pass, and the Kilbuck Mountain area.

An area of geothermal potential exists in the valley bottom near Tuluksak and moderate oil potential exists in the Kuskokwim Basin south of Aniak. A small basin near Sleetmute and Stony rivers has a low oil and gas potential.

Coal-bearing rocks have been reported at several localities including one in the Cheeneetnuk River, a tributary of the Swift River.

The Kuskokwim Subregion witnessed the flourishing and decline of an extensive minerals prospecting and extraction industry. Some prospecting is continuing in both subregions but not at a level equal to the 1930's. If any of the above potentials prove worthy of development, it can logically be expected that nearby forests will be harvested to support the development.

Antiquity values in the forested areas appear low since most of the work has been conducted in the coastal zone and little work has been done in the interior areas except for historical notations since the white man's settlement in the area. It can be expected that fish camps and other forms of aboriginal settlement would be similar to known settlement patterns along other interior streams.

FOREST VALUES

As stated earlier, the forest resources of the two subregions are similar concerning ecosystem composition. Also noteworthy is that local timber played such an insignificant role in the local economies and was generally not utilized for construction or other uses in the development of the mining or fishing industry to any appreciable degree. Local timber was used to a small degree in community building projects, at mine sites, in the villages, and for firewood.

In the absence of the development of a mineral extraction and processing industry in the Kuskokwim Bay Subregion it appears that the only natural resource development which could contribute significantly to the regional economy is the development of a forest products industry. The expansion of the fishing, fur harvesting, or significant mineral development appear unlikely in the near future; however, tourism and recreational hunting and fishing can realistically be expected to increase but to what extent is questionable (Berg, 1965).

The economic benefit from the forest products industry would probably come from export abroad of timber or finished products from local forests and from local and regional consumption. The primary timber species would logically be white spruce and some balsam poplar which are the characteristic species of the bottom land spruce/poplar ecosystem. These species are the most readily accessible and yield

the highest commercial volume per acre of all the forest types. This ecosystem is also along all the major water transportation corridors and most readily accessible to transportation of any type of timber product. If one were to speak in terms of economic commerciability, this forest type is the most commercial of the three interior forest ecosystems.

Some commercial forest stands of the upland spruce/hardwood ecosystem contain excellent birch, spruce, and aspen and could have an economic value when and if access is provided to them, and a need for their utilization is expressed. The stands of this ecosystem and even the small black spruce trees of the lowland spruce hardwood type could be considered a storehouse of fibre on the stump for future use in a pulp, chip, or hardboard industry at some centrally located Alaskan mill or a mill abroad. The trees are also a seed source for future forest regeneration. The eventual utilization of the forest resources on the presently noncommercial lands for fibre processing industries should not be ruled out.

In 1963, an application for a 715 million board feet, 10 year timber sale in the Kuskokwim River Valley was submitted to the BLM by Alaska Resources Inc. which specified Japan as the timber market (Berg, 1965).

It has been stated that if the timber would have been harvested at the time of application that the economically depressed situation would be alleviated (Berg, 1965). However, it appears that the high rate of timber harvesting could deplete the resource base or at least exceed growth rates and then after the sale expires, the economic activity would cease leaving the region in the same depressed situation as when the earlier mineral activity ceased.

A recent U.S. Forest Service Inventory of the forest resources of the bottom land spruce/poplar ecotype determined a net saw timber volume of 1,238,400,000 board feet with a net annual growth of 35 million board feet for all species and 1,110,900,000 board feet net volume for white spruce with a net annual growth of 25.6 million board feet (Timberland Statistics of the Kuskokwim River, May 1971). These volume figures cover the 249,800 acres of commercial stands and 70,400 acres of stands of low productivity for the entire length of the Kuskokwim River Valley. The low productivity or subcommercial stands have trees large enough to be considered piling or saw timber containing enough volume per acre to be worth harvesting. This covers roughly a strip one mile on either side of the river and over 600 miles long in the Kuskokwim Valley, plus the major feeder drainages. Another BLM study covered 11 million acres and determined an annual cut of 10 million board feet of spruce (Thompson, 1968).

Taking only the growth figures as an indicator of sustained yield harvesting 35 million board feet for all species, 25.6 million board feet of white spruce could be cut annually. The proposed sale application would have cut about 71 million board feet annually for a ten year period. The figure appears to be well over a sustained yield cut and in a harvesting zone stretching over hundreds of miles which would require moving the logging camp every few weeks. This volume is not unreasonable to cut in a large forest where the sale area is concentrated into a few townships, but is an ambitious harvesting schedule when stretched out over such a long, narrow corridor.

The 35 million board feet of growth refers to the total annual growth of all species (see growth table in appendix) and is located in the shaded area on the map representing the 1971 report study area. This volume is roughly equivalent to 4,135,000 cubic feet of growth. If we assume that a pulp mill operates 24 hours a day and produces 100 tons of pulp by the sulfide process daily, the entire annual growth harvest would be sufficient to operate such a pulp mill only 309 days. Three hundred fifty days is normal annual operation. A 100-ton per day mill is the minimum output allowable on the west coast. Each of the existing Alaskan pulp mills produce 500 tons daily. The 35 million board feet could support a fairly large integrated sawmill which could cut 100,000 to 200,000 board feet daily such as the mill at Haines if it were feasible to transport timber so many miles downstream to a processing point.

Considering the long transportation distances and practical seasonal time, restrictions on transporting timber from the stump to a mill, probably near Bethel, would require cutting much of the standing inventory plus ingrowth in concentrated areas to supply a relatively high volume mill. This will cut the programmed annual harvest or effectively "mine" the forest resource at a rate exceeding growth, and natural regeneration. White spruce requires about five to eight years to become established and about 16 years to reach breast height (4 1/2 feet). Aspen requires one to two years and birch requires three to five years to establish a new forest in the Kuskokwim area (University of Alaska data).

Several sawmills are located in the Kuskokwim Bay Subregion. There is a mill located at Lower Kalskag which is scheduled to be moved to Medfra to saw timber for village use (25,000 board feet BLM timber sale); one mill already at Medfra which has not been operated for years; a mill at McGrath; one near the Stoney River; and one near Russian Mission. This last mill operates most often and recently was granted a 311,000 board foot timber sale at $4.25 per 1,000 board feet for spruce. The markets are local customers along the river and Bethel for logs and lumber.

EXPLANATION OF FORESTRY TERMINOLOGY

COMMERCIAL FOREST LAND: This term is used in a slightly different manner than most people are accustomed. The term refers to a growth potential of a site - the volume growth rate of the resource. For this report for example, there are 2,972,000 acres of commercial forest land in the Kuskokwim Bay Subregion. Each acre is capable of producing 20 cubic feet of timber volume annually which is equivalent to about 1/5 of a cord of wood or about ten, eight foot long 2X4's.

Normally commercially refers to sites producing over 20 cubic feet per acre annually, but for this report one set of data goes as low as 15 cubic feet for commercial forest land. The terms commercial and subcommercial are applied to any stand capable of producing this minimum volume regardless of stand location or access and independent of any transportation means, availability of a market or manufacturing location or product price.

This type of land is found in the bottom land spruce/poplar (number 2) ecosystem and on the better sites in the number three ecosystem, the upland spruce/hardwood primarily on well-drained soils and southerly slopes.

NONCOMMERCIAL LAND: This is land which produces volume growth less than 15 or 20 cubic feet annually, depending on which minimum figure is used. Most noncommercial stands are in bay areas or northerly slopes stocked by black spruce and larch with isolated islands of hardwoods. Often entire hillsides or flat lands support dense aspen stands which are noncommercial due to dry soil and the resultant slow growth.

The number four lowland spruce/hardwood type can be considered totally noncommercial. Various stands in the number three type, upland spruce/hardwood also fall into the noncommercial category.

SUBCOMMERCIAL LANDS: These are sites which have a production level of between 15 and 20 cubic feet annually. Many stands fall into this category due to slow growth, even though the standing volume is relatively high and/or trees are large enough to be cut for various products. This report will consider operable noncommercial forest stands as subcommercial. They do not appear on the map as such, but occur as isolated stands predominantly in the number three upland spruce/hardwood ecosystem and occasionally in the number four bottom land spruce/hardwood type.

SAW TIMBER: Hardwood saw timber is a tree whose diameter is larger than 11 inches measured at breast height (4 1/2 d.b.h. feet above the root collar aground). Spruce saw timber is greater than nine inches d.b.h.

POLE TIMBER: This is timber whose d.b.h. ranges between five inches and nine inches for spruce and five to 11 inches for hardwoods.

GROWING STOCK: Growing stock is all live timber larger than five inches d.b.h.

TIMBER STATISTICS

These statistics are presented from two different reports. One set of data, the 1967 Statistical Survey, covers the entire drainages basin including the bottom land white spruce/poplar ecosystems, the upland spruce/hardwood ecosystem and those commercial areas within the basically noncommercial lowland spruce/hardwood type (Forest Statistics for Alaska's Forest Resources, 1967). The other set of data, dated May 1971, was generated from a relatively intensive forest survey covering primarily the bottom land spruce/poplar ecosystem which is representative of most of the commercial and operable timberland in the subregion.

DATA TABLES

Area of Forest Land

Four land types are mentioned, commercial, subcommercial, noncommercial, and nonforest land. By comparing the percentage composition of any of these to the total acreage, it can be seen that commercial forest land occupies a relatively small area among the vegetative ecosystems. Even though the 1971 survey was taken in the bottom land spruce/hardwood

type which is predominantly commercial, it can be seen that only about one fourth of the total survey area has commercial and subcommercial forests. The balance of the area is water, brush or grassland or timberland supporting low volume black spruce and very slow growing stands. Referring to the other 1967 statistics, we can see that as the land area included in the survey covers more lands removed away from the river, the relative standing of commercial forest land decreases and noncommercial forests and nonforest land increases many fold. We also see that much of the commercial land in the subregion is located on the uplands far removed from the waterways and transportation routes.

Area by Stand Size Classes shows the relative area of commercial and subcommercial forest land in the various tree size classes. The table is self-explanatory except for acreages of commercial forest land in a nonstocked category. This means that a large expanse of basically nonstocked land (less than 18 percent covered by trees) has scattered stands of commercial trees, thus nonstocked land can contain commercial forest land acreage or a few scattered commercial trees in a less than 10 percent stocked surface area.

Area by Tree Species shows the relative standing of various timber species to each other under both surveys. It can be seen that aspen, for example, is probably a part of the bottom land ecosystem accept for limited trees.

Number of Growing Stock Trees shows the number of trees in two inch diameter classes by species. This table shows roughly the diameter grouping where most of the trees occur is in the pole timber and seedling sapling categories. Simple observation of a table such as this could aid the forest land manager in planning site treatment operations to attain maximum production, relative size of material to be harvested and type of harvesting equipment necessary, diameter growth for cutting objectives, and possibly which species to concentrate on.

Volumes of Growing Stock and Saw Timber by Species and Diameter Classes tables show where the volume is, which diameter inch classes the land manager could aim his maximum volume production at considering further site treatment, regeneration methods, desired species, and other considerations.

Net and Gross Volume Tables show the volume reduction due to defect. The net volume from the 1967 survey reveals that the Kuskokwim Valley produces about 14 percent of the state's commercial forest volume on 10 percent of the state's commercial forest land (Hutchison 1967 and Timberland Statistics for the Kuskokwim River, 1967). In this report two inventories are cited, the 1967 statistical report covering all the Kuskokwim Valley and the 1971 statistical report covering primarily the bottom land spruce/poplar (see map).

Net Annual Growth shows the approximate volume increase produced by each species in overall survey unit figures. These figures can serve as a very general indicator of the potential annual harvest on a sustained yield basis. Of course it is only an indicator, and additional data is necessary to evaluate the allowable cut.

DATA GAPS

The data presented here comes from two Forest Service reports plus other papers. Because many of the proposed forest industry development potentials cannot be based on these tables or on data, they are based on conjecture of what products could be produced from various raw materials grown on the region's forests. No values are assigned to these products, but they are mentioned because there is a potential for income and an economic benefit to the region.

The forest data will probably need to be applied to a one inch per mile map to give an accurate picture of volumes, species, ages, acreages, and where they are located. Additional data may not be necessary at this time, but the existing data needs to be applicable to smaller units not as an entire survey unit.

FOREST STATISTICS

AREA OF FOREST LAND (in acres)

	1967 Survey [1]	1971 Survey [2]
Commercial	2,972,000	249,800
Subcommercial	--	70,400
Noncommercial	11,689,000	554,700
Non Forest Land	11,902,000	356,200
Total	26,563,000	1,231,100

AREA OF COMMERCIAL AND SUBCOMMERCIAL FOREST LAND BY STAND SIZE CLASSES

	1967 Survey	1971 Survey
Nonstocked	140,000	7,300
Seedling/sapling	908,000	16,600
Pole Timber	812,000	105,600
Saw Timber	1,112,000	190,700
Total	2,972,000	320,200

AREA BY TREE SPECIES

	1967 Survey	1971 Survey		
	Commercial Includes subcommercial	Commercial	Noncommercial Operable (subcommercial)	Noncommercial Inoperable
Black Spruce			2,700	522,200
White Spruce	1,830,000	146,900	43,900	11,900
Balsam Poplar	219,000	38,900	2,700	
Birch	714,000	56,700	21,000	18,700
Aspen	209,000			1,900
Total	2,972,000	242,500	70,300	554,700

[1] Extensive survey.

[2] Intensive survey of bottom land spruce/poplar ecosystem.

NUMBER OF TREES ON COMMERCIAL FOREST LAND BY SPECIES

(1971 Survey)

(Thousand trees)

Species	Diameter class (inches at breast height)												
	All classes	1.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.8	15.0 - 16.9	17.0 - 18.9	19.0 - 20.9	21.0 - 28.9	29.0-
White spruce	34,918.0	8,509.4	6,350.9	5,795.4	5,023.9	3,512.3	2,791.8	1,488.3	844.1	360.1	154.1	87.7	0
Paper birch	28,577.3	9,348.0	7,542.9	5,843.7	3,648.9	1,620.6	443.1	118.9	11.2	0	0	0	0
Balsam poplar	7,994.4	2,399.2	983.4	1,081.5	1,215.6	1,114.3	670.8	349.6	130.5	28.5	18.8	2.2	0
Quaking aspen	309.8	64.6	0	0	123.9	121.3	0	0	0	0	0	0	0
Total	71,799.5	20,321.2	14,877.2	12,720.6	10,012.3	6,368.5	3,905.7	1,956.8	985.8	388.6	172.9	89.9	0

V O L U M E [1/]

NET VOLUME OF SAW TIMBER ON COMMERCIAL FOREST LAND BY SPECIES

	1967 Survey	1971 Survey	
	Commercial	Commercial	Subcommercial
White Spruce	3,761,913,000	980,100,000	130,800,000
Balsam Poplar	276,389,000	95,100,000	2,200,000
Birch	348,335,000	27,300,000	3,000,000
Aspen	98,244,000	--	--
Total	4,484,861,000	1,102,500,000	136,000,000

1/ All volumes are in International 1/4 inch. board foot rule.

Net volume of growing stock on commercial and subcommercial forest land, by species and diameter classes

(Million cubic feet) 1971 Survey

Species	Diameter class (inches at d.b.h.)										
	All classes	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20,9	21.0-26.9	27.0+
Softwoods:		Pole		Sawtimber							
White spruce	291.8	19.9	40.7	56.0	58.6	47.2	33.3	19.2	9.3	7.6	0.0
Total	291.8	19.9	40.7	56.0	58.6	47.2	33.3	19.2	9.3	7.6	0.0
	21%	60.6									
Hardwoods:											
Paper birch	70.6	18.5	25.8	17.6	6.4	2.1	0.2	0.0	0.0	0.0	0.0
Balsam poplar	40.2	2.4	6.3	9.9	9.4	7.1	3.2	1.1	0.6	0.2	0.0
Quaking aspen	2.5	0.2	0.9	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	113.3	21.1	33.0	28.9	15.8	9.2	3.4	1.1	0.6	0.2	0.0
	73%	83.0									
Total, all species	405.0	41.0	73.7	84.9	74.4	56.4	36.7	20.3	9.9	7.8	0.0

Net volume of sawtimber on commercial and subcommercial forest land, by species and diameter classes

(Million board feet[1/])

1971 Survey

Species	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods:		Saw Timber							
White spruce	1,110.9	225.5	273.6	237.9	174.9	104.1	52.0	42.9	0.0
Total	1,110.9	225.5	273.6	237.9	174.9	104.1	52.0	42.9	0.0
Hardwoods:									
Paper birch	30.3	0.0	21.8	7.5	1.0	0.0	0.0	0.0	0.0
Balsam poplar	97.2	0.0	40.6	31.4	15.7	5.4	2.9	1.2	0.0
Quaking aspen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	127.5	0.0	62.4	38.9	16.7	5.4	2.9	1.2	0.0
Total, all classes	1,238.4	225.5	336.0	276.8	191.6	109.5	54.9	44.1	0.0

1/ International 1/4-inch rule.

GROSS VOLUME OF SAW TIMBER ON SUBCOMMERCIAL AND COMMERCIAL FOREST LAND BY SPECIES

	1967 Survey	1971 Survey	
		Commercial	Subcommercial
Spruce	NO DATA	1,052,100,000	139,500,000
Balsam Poplar	NO DATA	115,700,000	3,500,000
Birch	NO DATA	33,700,000	3,600,000
Aspen	NO DATA	--	--
Total		1,201,500,000	146,600,000

G R O W T H

NET ANNUAL GROWTH OF SAW TIMBER

	1967 Survey	1971 Survey	
	Commercial	Commercial	Subcommercial
White Spruce	66,254,000	19,490,000	6,103,000
Balsam Poplar	5,143,000	7,519,000	24,000
Birch	12,723,000	4,953,000	13,000
Aspen	4,953,000	--	--
Total	89,073,000	28,841,000	6,140,000

MORTALITY

The mortality figures for the 1971 survey indicate the annual loss of timber to be about 1.5 million board feet. The primary causes of mortality in spruce are insects (bark beetles) and wind throw (Hutchison, 1971). Hardwoods, birch, aspen and poplars appear to be effected by disease (heart and root rots), animal browsing and a variety of other mortality factors more than are the conifers. The hardwoods are also shorter lived than the conifers and generally tend to have a higher incidence of rot than conifers of the same age. The aspen and birch stands begin to breakup about 60 to 80 years of age.

FOREST PRODUCTS AND DEVELOPMENT POTENTIAL

Most of the bottom land spruce/poplar ecosystem is basically commercial forest land; half the acreage supports commercial forests and indicates that the type is understocked. Much of the region could produce more volume on more forested acreage if site treatment, seeding or planting were undertaken. Looking, however, at the existing crop of trees and volume available to harvest, it appears that a sizeable timber industry could be established which could gainfully employ local residents and benefit the regional economy. The 35 million annual growth figure for the entire river side ecosystem is impractical to harvest for processing by a single large mill. However, several small portable or stationary sawmills or chippers could process a sizeable quantity of cants, lumber, siding, shakes, three sided logs or other lumber products for local use, regional use, or export intrastate or abroad on a nonscheduled or low volume level.

The several existing mills in the region are generally rated at cutting about 5,000 to 6,000 board feet daily. At that rate, each mill could cut enough wood to build one house every two days. Each of these mills process about 1,000,000 to 2,000,000 board feet of timber annually. Theoretically, such mills could operate in the valley.

It can be assumed that at various periods of time certain projects will require large amounts of timber from a certain area, and the possibility exists that area could be timber "mined" to supply such a project with wood. One such need for timber could result from oil or mineral exploration and development and related construction activity or a housing project like the one at Bethel. The size class distribution tables show that the predominant number of trees is in the pole timber category.

Other forest products which could generate income for the region are charcoal manufacturing from hardwoods, willow, and alder; firewood from birch and spruce; furniture stock and box and pallet stock from birch, aspen and poplar respectively; various cottage industry products utilizing birch and poplar bark; and other raw materials from the forests. Local birch syrup processing could be feasible and profitable as demonstrated by Carrol Philips' syrup operation in Fairbanks. Smaller trees are usable as fence posts. Chips manufactured from waste material, driftwood, live timber or whatever could be collected and exported for additional processing abroad or at a U.S. mill. The possibility of cutting prime logs for veneer manufacturing should not be ruled out.

Many products could be manufactured from local timber if and when national, international or state needs become great enough to stimulate the development of industries to produce the above mentioned products.

BRISTOL BAY SUBREGION

Introduction

The three interior forest ecosystems described on page 1 and 2 are also found in this subregion.

The bottom land spruce/poplar type listed as Number 2 on the maps covers about 669,000 acres and is found in the flood plain and adjacent benches of the Alagnak River, Mulchatna and Nushagak and in fairly narrow strips along the Nuyakuk River and many more minor streams. Some isolated pockets of white spruce are found along the Togiak River and a stand of balsam poplar is growing at Lake Togiak.

Type Number 3, the upland spruce/hardwood covers roughly 2.8 million acres, and forest is found on well drained soils, on southerly slopes, of the upper reaches of the Nushagak and Mulchatna Rivers; around the Tikchik Lakes from Lake Chanekuktuli to Dillingham and Sparks; around Lake Clark and along its major feeder streams and the Newhalen River; along the slopes on the northeastern and southern shores of Lake Iliamna; and scattered stands near the lakes in Katmai National Monument to the southern limit of the forest type on the south shore of Lake Brooks.

The Number 4 forest ecotype, the lowland spruce/hardwood type, covers about 1.5 million acres. Most of this ecosystem is located primarily in the large basin between the Tikchik Lakes and Nushagak River, a belt east of the Muchagak River and an area on the north and southwest shores of Lake Iliamna.

FOREST LAND STATUS

In the Bristol Bay Subregion, the upland forest types of the Upper Mulchatna, Taylor Mountains, Wood River, Tikchik Lakes area south to Dillingham are under Native Regional Corporation auspices.

State selection as are some bottom land forests along the Upper Mulchatna and Nushagak Rivers. The major timber volume primarily from the bottom land forest type appears to be destined for Native villages and regional corporation control, as does some upland forest land near Lakes Iliamna and Clark. Other upland forests near Lake Clark, Naknek and Brooks, Iliamna, and the general vicinity appear destined to remain in federally controlled d-2 lands along with the lowland forests east of the State tentatively approved lands around the Tikchik Lakes. That land is presently undergoing study for inclusion in the State Park System. The federal lands around Lake Iliamna had been classified for multiple use.

The lowland black spruce type in the vicinity east and west of the Mulchatna, Nushagak Rivers appear to be predominantly in federal d-1 lands and some in Native village and regional selection lands and a minor portion of the western extent of the type in State tentatively approved land. The lowland type at the west end of Lake Iliamna lies in federal d-2 and Native selection lands.

ACCESS AND TRANSPORTATION

Access and transportation in the Bristol Bay Subregion are via three methods.

1. Aircraft, including helicopters and balloon landing either on landing strips, snow or open water;
2. overland via all terrain vehicles in all seasons or on the few roads in the area;
3. water travel on rivers and lakes.

Various aircraft types could be used to transport people into any of major forest production zones and transporting finished or raw materials out of the area depending on product weight, size, and aircraft limitations. Aircraft can also ferry portable harvesting and processing equipment into an accessible area. Smaller aircraft can land on the Mulchatna and Nushagak Rivers while larger aircraft are restricted to deeper waters and larger lakes such as the Tikchik, Iliamna, and Clark Lake. Some airstrips are present in the region, but are usually near villages which are established on rivers, lakes or along the coast. Winter landings on snow strips could provide for forest product transportation to regional centers such as Dillingham or King Salmon. Helicopters and balloons could be used in timber harvesting and short distance transportation depending on many economic considerations such as availability and cost of alternate materials, substitutes for wood and the final product value.

Overland transportation of personnel or timber products can be achieved over the frozen terrain in winter or along the few existing roads such as from Cook Inlet to Lake Iliamna or from Dillingham to Alagnagik.

Boat transportation on rivers and lakes appears to be the most practical method of transporting timber or processed materials from place of harvest to markets or regional transportation centers.

Because of the great number of side sloughs, oxbows and old channels, logging activities and personnel transportation would be more complicated. Camps would have to be moved often as the resource grows basically as a ribbon of trees along the rivers. The upland forest types would be less accessible from rivers, but are often accessible from large lakes like the Tikchik Lakes system or Lakes Clark and Iliamna.

GENERAL FOREST USE

From a scenic aspect, the forests of the Bristol Bay Subregion play an important roll since they are located in areas well suited to increased tourism. The forests around the Tikchik Lakes and Lake Clark, the trees and forest remains in Katmai National Monument, the forests along the Nuyakuk, Nushagak, Mulchatna and other rivers all add variety of texture and color to the scenic beauty of the area. Forests enhance the quality of recreation experiences for general tourists as well as fishermen and hunters.

The Tikchik Lakes system, Katmai National Monument, Lake Iliamna, to mention a few, attract recreation fishermen from all over the world. A portion of the enjoyment of the area in addition to its fishing and hunting value, is the forest-enhanced scenery. The proper management of the forest ecosystems should take into consideration watershed and soil erosion protection and other factors where the forest influences fish and game habitat.

The forests of the Bristol Bay Subregion are an important factor in the fish and wildlife environment, offering food, shelter, nesting sites, soil and bank retaining stability, and to a degree, stream temperature control, maintenance of soil moisture balance and seed source for forest regeneration and expansion into unforested land. Any forest manipulation should evaluate the impact such manipulation would have on soil and watershed stability. The protection of forests from insect, disease, and fire should be considered in a resource management plan in light of all of the above. Alternate or multiple uses of forest lands of the bottom land spruce/hardwood ecosystem and some areas of the upland forest ecosystem near the villages are indicators that the soils have some agricultural potential at least for garden purposes. No domestic animal or reindeer grazing is reported in the forests, but the forests are part of the natural range.

Subsistence hunting and fishing take place along some of the forested river banks and lake shores. Other associated subsistence activities include gathering berries, roots, and other vegetation for food, dyes, medicines, vessels, tool and boat making, wood for fuel, and some trapping fur-bearing animals for food, clothing and trading.

The major mineral occurrences in the Bristol Bay Subregion appear to be in the Lake Clark and Lake Iliamna area, and east of Mulchatna River, and in the Taylor Mountains area.

The oil and gas potential under forested lands is moderate and high in the Nushagak/Mulchatna drainage downstream from Ketch Mountain/Koliganek and the western end of Lake Iliamna and some portions in Katmai National Monument. There is no geothermal essential, as coal bearing rocks have been reported in the forest lands.

The Bristol Bay Subregion never had the mineral exploration and development that the Kuskokwim Bay Subregion experienced. Some prospecting is continuing in both subregions but not at the intensity of the 1930's.

Antiquity values in the forest areas appear low primarily because little work has been conducted in the forested areas. However, some archaeological and historical finds have been located and a small number studied in detail along the Kuyakuk, Wood, and Lower Mulchatna Rivers, Nushagak Bay, Tikchik Lake and Lake Clark at the mouth of the Kijik River.

Some older sites around Lake Iliamna have been discovered. The Naknek drainage has known sites dating from 2500 B.C. Most of the sites in the subregion are along streams, lake shores and along the coast.

FOREST VALUES

As stated earlier, the forest resources of the two subregions are similar as it concerns ecosystem composition. Also noteworthy is that local timber played such an insignificant role in the local economies and was under-utilized for construction or other uses in the development of the mining or fishing industry. Local timber was used to a small degree in community building projects at mine sites or in the villages and for firewood. The Bristol Bay unit has a fisheries resource base and growing tourist sportsman industry to maintain its regional economy. The forests in this subregion would probably not contribute significantly to the regional economy when compared to commercial fishing and the expanding tourist and recreation industry, however, harvesting regional timber could supply local wood requirements for many uses, and employ a few workers gainfully.

The economic benefit from the forest products industry would probably come from local and regional consumption and from export abroad of timber or finished products. The primary timber species harvested would logically be white spruce and some balsam poplar which are characteristic of the bottom land spruce/poplar ecosystem. They are

the most readily accessible and yield the highest commercial volume per acre of all the forest types. If one were to speak in terms of economic commercialability, this forest type is the most commercial of the three interior forest ecosystems.

Some commercial forests stands of the upland spruce/hardwood ecotype contain excellent birch, spruce and aspen and could have an economic value when and if access is provided to them and a need for their utilization is expressed. The stands of this ecosystem and even the small black spruce trees of the lowland spruce/hardwood type could be considered a storehouse of fibre on the stump for future use in a pulp/chip or hardboard industry either at some centrally located Alaskan mill or a mill abroad and as a seed source for future forest regeneration. The eventual utilization of the forest resources on the presently noncommercial lands for fibre processing industries should not be ruled out.

FOREST INVENTORY DATA

The only forest inventory conducted in the subregion was very extensive. It covered all forest ecosystems within the natural hydrologic basin from the mountain ridges on the north, east and west to the forest just south of Lake Iliamna. The actual forest front-extreme range of trees - is further south below Brook Lake with scattered black spruce found further west and south to about the King Salmon River.

The data from this inventory is included in tables of Keith Hutchison's "Alaska Forest Resource" (1967). The data presented here is taken from preliminar statistical tables furnished by the forest service. An explanation of terminology follows:

Commercial forest land is land stocked with trees adding volume growth at a minimum annual rate. The volume growth is usually 20 cubic feet per acre per year or about 50 to 60 board feet. However, for this report, the subcommercial forest statistics were included under the commercial heading. Subcommercial includes volume growth of from 15 to 20 cubic feet per acre per year or trees and stands of sufficient harvesting size to be sawn into lumber but growing too slowly to be considered purely commercial.

The term "commercial" as used in this report, refers only to a growth rate and has no reference to transportation, accessibility, market demand or location. A commercial stand of timber can be a vigorous stand of spruce in the Mulchatna River flood plain or a remote stand of birch or aspen on a hillside 100 miles from a stream or road.

"Noncommercial" refers to stands of timber producing less than 15 cubic feet of volume growth/acre annually.

Saw timber is separated from pole timber by trunk diameter measured at breast height (4.5 feet above root collar) abbreviated "dbh". For spruce, pole timber ranges from five to nine inches dbh, and saw timber, everything over nine inches dbh. Hardwood (poplar, birch and aspen) pole timber ranges from five to 11 dbh and saw timber above 11 inches dbh. Seedling and sapling stands are stands of trees with diameters less than five inches.

A R E A

Commercial Forest Land		Acres
Seedling/sapling		297,000
Pole Timber		419,000
Saw Timber		169,000
Non-stocked		22,000
	TOTAL:	907,000
Non-commercial		1,834,000
TOTAL FOREST LAND		2,741,000

Area of Local Forest Type on Commercial Forest Lands

White Spruce		657,000
Birch		125,000
Poplar		125,000
Aspen		----
	TOTAL:	907,000

This acreage figure is only an indicator of the approximate number of acres of which the dominant forest type is one of the named species. No acreage is predominantly populated by aspen, yet, there are aspen on several types and aspen volume appears in some of the following tables.

VOLUME

Volume of saw timber by species and quality classes in 1000 board feet

(International 1/4 inch board foot)

SPECIES	GRADE				
	1	2	3	4	TOTAL
Spruce	5,431	12,498	395,074	157,993	570,996
Aspen	1,210	790	1,843	86	3,929
Birch	469	799	9,766	411	11,445
Poplar	---	1,888	3,362	189	5,439
TOTAL	7,110	15,975	410,045	158,679	591,809

The above grades 1 through 4 show best (1) to poorest (4) quality. The best quality would indicate the largest trees most free of visible defects and almost clear of knots. As the grades progress through 2, 3, to 4, the tree diameters become smaller; more knots and other defects appear which reduce the quality of the log and limit the type of final product which can be produced. All trees can be utilized for fibre products regardless of grade. Less than 10 percent of the total volume is in the best grade and of that, nearly all of it is associated with the bottomland forest ecosystem. Over 90 percent of the timber falls into quality classes 3 and 4, but is nevertheless of economic importance locally, because it can be utilized for house logs, sown into lumber for various uses, used for other products despite its smaller size and greater number of knots when compared to the number-one grade.

The average volume per acre is an expression which reveals the relative productivity of one site or forest stand versus another or the average productivity of any area versus any other. The average volume per acre for the entire commercial forests of the Bristol Bay Subregion is 652 board feet

for both hard and soft woods. This could range from less than 100 board feet per acre to 3,000 board feet per acre measured in a one field plot. Some bottomland stands could have 10,000 board feet per acre, but those few and far between.

The volume of salvable dead timber is timber which is dead less than five years and is still in condition to be processed.

Annual growth for all species is 12,6 million board feet. White spruce growth is 11.9 million and all hardwoods combined are 0.7 million board feet.[1/]

There are several methods for calculating the potential annual harvest. However, for these very extensive inventories, only a rough extimation based solely on volume growth is presented here. The subregion wide annual harvest of volume growth only could be about a million board feet, however, all of the commercial timber is not presently accessible. Therefore, it would be a misrepresentation to state that the potential harvest could be that entire 12 million board feet. The timber most easily harvested is that most accessible to roads, lakes, streams or landing strips. It will be harvested first and most of that volume will come from the bottomland ecosystem. Some will come from the upland type bordering lakes. A more conservative annual harvest projection could be set at about 6 million board feet. This is relatively little harvestable timber, but it can supply two or three typical village sawmills which can cut about 5,000 board

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1/ All the above statistics are cited from "Forest Statistics for Alaska's Forest Resources -- Bristol Bay Unit" (1967).

feet daily primarily for local use.

ROTATION AGE or approximate age of maturity at which can be harvested for lumber products can be from 120 to 140 years. This includes the 10-15 years required for trees to reach recording height (dbh at 4.5 feet). This is referred to as the regeneration age.

The actual rotation age can vary depending on the type of product to be produced. Fibre products could be produced from smaller trees and generally would require lower rotation ages than would higher quality logs for houses, clear lumber or veneer. This is strictly a management decision once a forest management good for the subregion has been established.

Several mills are now set up at villages, and at some lodges along Lake Clark and in the Tikchik Lakes area. New Stuyakok, Ekwok, Nondalton, Dillingham and Port Allsworth reportedly have small saw mills, but their generation is probably sporatic (BIA 1973 and Clapp 1972). They cut timber and logs for homes, cabins, lodges and other local use.

The mills located at New Stuyakok, Ekwok and Dillingham would cut primarily white spruce from the bottomland ecosystem while the mills at Nondalton and others at Lake Clark could cut spruce, aspen and birch from around Lake Clark and also saw wood from the nearby hills from the upland hardwood spruce ecosystem. The BLM recently appraised the timber for one Kuskokwim Valley sale at $4 per thousand board feet ($4.00/MBF) and the operator of the mill desiring the sale increased the minimum appraisal to $4.25/MBF. This value can be assumed to be a guide to stumpage value. Cordwood could sell for about $1/cord and retail for between $20 to $40 per cord.

FOREST PRODUCTS AND DEVELOPMENT POTENTIAL

Most of the bottom land spruce/poplar ecosystem is basically commercial forest land; half the acreage supports commercial forests and indicates that the type is understocked. Much of the region could produce more volume on more forested acreage if site treatment, seeding or planting were undertaken. Looking, however, at the existing crop of trees and volume available to harvest, it appears that a limited timber industry could be established which could gainfully employ a few local residents and benefit the regional economy. The six million annual harvest for the entire riverside ecosystem is impractical to harvest for processing by a single mill. However, several small portable or stationary sawmills or chippers could process a sizeable quantity of cants, lumber, siding, shakes, three-sided logs or other lumber products for local use, regional use, or export intrastate or abroad on a nonscheduled or low volume level.

The several existing mills in the region are generally rated at cutting about 5,000 to 6,000 board feet daily. At that rate, each mill could cut enough wood to build one house every two days. Each of these mills process about 1,000,000 to 2,000,000 board feet of timber annually. Theoretically, such mills could operate profitably in the subregion.

It can be assumed that at various periods of time certain projects will require large amounts of timber from a certain area, and the possibility exists that area could be timber "mined" to supply such a project with wood. One such need for timber could result from oil or mineral exploration and development and related construction activity or a housing project like the one at Bethel. The size-class distribution tables show that the predominant number of trees is in the pole timber category.

Other forest products which could generate income for the region are charcoal manufacturing from hardwoods, willow, and alder; firewood from birch and spruce; furniture stock and box and pallet stock from birch, aspen and poplar respectively; various cottage industry products utilizing birch and poplar bark and other raw materials from the forests. Local birch syrup processing could be feasible and profitable if sufficient birch are present in a concentrated area as demonstrated by Carrol Philips' syrup operation in Fairbanks. Smaller trees are usable as fence posts. Chips manufactured from mill waste material, driftwood, live timber or forest waste material could be collected and exported for additional processing abroad or at a U.S. mill. The possibility of cutting prime logs for veneer manufacturing should not be ruled out.

Many products could be manufactured from local timber if and when national, international or State needs become great enough to stimulate the development of industries to produce the above-mentioned products.

ALEUTIAN ISLANDS SUBREGION

Introduction

There are today, no natural forests or trees on the Aleutian Islands. However, a history of tree planting has continued with various rates of success from the first known plantings by the Russians about 1805, to the present time.

The natural forest range on the Pacific side of the Alaskan Peninsula extends southward to Kaflia Bay about 10 miles south of the southern limit of Hallo Bay. However, Griggs (1934) reports a grove of Sitka spruce as far south as Cape Kubugakli at the southern limit of Katmai Bay. Isolated cottonwoods may be found farther south. Thus, the coastal forest ecosystem extends along the rain and fog belts from the Oregon/Washington Coast through Southeastern Alaska, becoming a pure Sitka spruce system sprinkled with river bottom poplars on the Kodiak Island group, and on the west Cook Inlet shores to reach a southern range limit at Cape Kubigakli on the Alaskan Peninsula. No natural trees are found on the Aleutian Island Chain.

The cause for the change in vegetation is not readily apparent. The soil and climate characteristics are not altered so abruptly that trees should not grow a few yards away from where they are found. There is, to date, no final answer as to why natural trees do not grow on the chain, although climatic factors, usually low temperatures, are blamed for lack of trees.

BACKGROUND HISTORY

The islands were once forested as evidenced by the petrified wood found on Amchitka and other islands, and by the petrified large bogs and stumps (the largest is 9 feet in diameter) found on Unga Island (Eakins, 1970).

The fossil logs and stumps on Unga Island were identified as belonging to the genis Sequoia (redwood) or Metasequoia (dawn redwood) (Eakins, 1970). These become extinct in Alaska late in the Niocene epoch, about 13 million years ago (Eakins, 1970, Harris, 1973). However, the Sequoia are still found in California. The dawn redwood (metasequoia) which was presumed to be extinct, was found in China in the 1940's. It has been transplanted to many other parts of the world, including Alaska, its former Native range in warmer times. One tree out of nine planted at Mt. Edgecumbe School in 1950 is still alive. (Harris, 1973.) The actual boundary between forested and nonforested area is due in part by small changes in the soil character, drainage, permafrost action, depth and the interaction of all aspects of the local environment, but these boundaries are shifting so soil may be less of a factor than climate. Generally speaking, the tree fronts in Alaska are a dynamic situation and are migration fronts rather than stable, climatic boundaries. However, it will probably be several generations before the tree front migrates down the Alaskan Peninsula to the Aleutian Chain if it ever does at all.

CLIMATIC EFFECTS

Hopkins (1959) had determined a climatic yardstick to determine the potential of an area to support forest growth. He bases this on an annual temperature regime - degree days established as follows. The differences between the mean daily temperatures above 50° F and the 50° F base temperature are added together.

If the sum equals 130 degree days or more, the area can be expeced to produce forests. All of Alaska's existing forested areas fall into this minimum 130 degree day concept using 50° F as a base temperature. However, many areas, presently unforested, such as parts of the Aleutian Islands, Middleton Island, the Alaska Peninsula, and Kodiak Island, should support tree growth since they have enough warm days (over 50° F) to exceed the 130 degree day minimum. Other climatic factors may be influential in slowing or preventing the absence of the tree front.

The wind and its direction could be a factor preventing trees from spreading their range or becoming established. If the wind is blowing from an adverse direction, seed could be blown out to sea or to areas where it cannot germinate. Wind-induced chill factor could kill off new seedlings. Abrasion by wind blown particles or the wind physically breaking the stem of a seedling, and desiccation of the plant where the wind could cause excessive evapotranspiration exceeding water

absorption by the root system are additional wind-related factors which could prevent tree establishment. The presence of a seed source is an obviously important factor, but seeds are carried via many methods, including water and wind, in animal fur or in stomach contents of migrating creatures.

EARLY AFORESTATION

There is no record of aboriginal people transplanting trees; however, their use of wood, usually drift, for dwellings and other community structures, boat building, and use in tools and weapons is documented.

Since the last ice age, the islands are completely unforested except for post contact transplanting. The Russian settlers were the first to go on record as having successfully transplanted trees and established a small stand of trees on Unalaska Island around 1805 (Lutz, 1805).

The first reference to those trees was by Adelbert von Chamisso, a naturalist accompanying the 1815-1818 von Kotzebue expedition (Lutz, 1963). He observed that most trees had perished, and others were scarcely surviving. Lutke and Veniamino later reported that the plantation was growing well about 22 years after the trees were planted; 24 trees were alive in 1834. From Chamisso's description, it appears that Sitka spruce seedlings were transplanted from the Sitka

area. Later reports confirm this, and one report states that 24 trees were living by 1834 (Lutz, 1963) and that in 1833, cones appeared on several trees. Further, tree plantations were carried out by Father Veniamino after 1835 at Unalaska Village, but the plantation evidently died as revealed by later reports which state that the only living trees are located on Amaknak Island at what is today called Dutch Harbor, where the original 1805 plantation was established.

The spruce were planted in a sheltered valley near a small lake, and several reports about 60 years after planting agree that cones form but the seed does not develop and become viable. A professional forester, Fernow, reported in 1901 that two small spruce trees were evidently products of heavy seed production by the main stand a little ways away. Later observations make no further mention of those two small trees, but goats, sheep and other domestic animals may graze the small trees if any do become established. By 1901, 19 trees still survived, but some were fire damaged, and the largest trees were 24 inches in diameter and all about 25 to 30 feet tall.

Evidently, the military filled in the pond with gravel to dredge the site. This action probably raised the water table and killed a few trees. A building fire also killed a few and as of 1958, 10 trees were still standing: six alive and four dead. The trees are producing viable seeds proved by the many five-inch high seedlings established on the exposed mineral soil and gravel fill. The 1958

observations conflict with some earlier reports, but these errors only reinforce the fact that every observer sees things differently or doesn't see some things observed and noted by others. The 1958 observations are significant because they are relatively current and are based on measurement and counts and are photographically recorded. It shows that under proper conditions trees can grow and produce viable seed which, in turn, produces trees where favorable seedbeds are available.

Additionally, other trees probably planted by Veniamino in 1934 to 1841 do still exist at the Unalaska Townsite contrary to their reports. Six of these trees are still alive and have average measurements of 19 foot heights, 12 inch diameters.

There are 53 trees (six are dead) planted near the military subbase acres, the small lagoon south of Dutch Harbor on Amaknak Island. Their diameters range from 3.5 to 19 inches.

All of the above information comes from Lutz's 1963 publication, "Sitka Spruce Planted in 1805 at Unalaska Island by the Russians." Many other plantations were attempted by various public agencies and private groups to "spruce" up the drab scene a bit. Most of the plantings between 1920 and 1940 were promoted by the U.S. Government, primarily, the U.S. Forest Service, the Indian Service and the Coast Guard (Bruce & Court, 1945). Most of these programs were not followed up on, and the plantations did not receive proper care.

Same of the plantations established before the war were planted on Umnak, Atka, Attu and another part of Unalaska. Several different tree species were planted. Most came from Washington and Southeastern Alaska, but some may have been transplanted from the Kuskokwim or Cook Inlet Region and were not recorded (Bruce & Court, 1945 and personal communications from several people). At any rate, only Sitka spruce appears to have survived on most of the islands. Of the above mentioned plantings, the ones at Dutch Harbor appear to be the most successful. In 1945, 85 trees were alive and grew to 20-35 foot heights. (Bruce & Court, 1945.) At Kashega on Unalaska Island, 11 out of 12 spruces planted in 1928 survived, but several other trees died. Bruce & Court (1945) continue to relate the military's aforestation program encouraged and established primarily by a Lt. General S. B. Buckner, Jr.

At Nikolski on Umnak Island, 18 trees were planted in 1936. Several years later, half of them were still alive but all had died by 1944. No trees survived the 1940 plantings on Atka and Attu Islands either, but one living tree near an abandoned barracks on Shemya Island still survives. (Al Feulner, 1973, personal communication.)

RECENT PLANTINGS

Adak Island has a fairly large military facility and benefited from an intensive tree planting effort in the 1940's.

In 1943, about 2,000 spruces (species and origin not known) were planted evidently in poor areas and using improper planting techniques and poor planting care. By 1944, only six trees still had green needles. (Bruce & Court, 1945.) Vern Byrd reports about 30 trees are still alive and that the Navy planted about 200 trees as ornamentals in the summer of 1972 evidently imported from a Seattle source. All have died.

During the war years, many thousands of trees and shrubs, including white, black and Sitka spruce, mountain hemlock, both poplars, birch, aspen, alder and willow were planted at or near the military installations from Attu to Kodiak Island. Sitka spruce appears to be the natural preferred species and has the highest survival rate. If more knowledge had been available to those responsible for the afforested projects and the actual planting supervised by knowledgeable people to insure correct planting procedures and site selection, the survival rate could have been much higher. However, much has been learned about tree survival and growth potential because of the military's afforestation efforts. Many civilians have become interested in

afforesting their immediate environment in and around villages. Some of these areas are at False Pass on the chain, Cold Bay on the Alaska Peninsula and on the Shumagin and Semidi Islands. (The following information comes from personal communication from Andrew Gronboldt, 1973.)

Sand Point on Popof Island in the Shumagins had a plantation of Sitka spruce established about 1906. Thirty-eight trees were planted. They were about 1 1/2 to 2 feet high and came from the Prince William Sound area. The trees are presently (1973) 44 feet tall and have 24-inch diameters. They are evidently prospering since they produce cones with viable seed.

Twelve large trees have grown on the edge of the original plantation. The trees are already 45 feet tall with diameters up to 10 inches as measured in 1973. About 20, two-foot seedlings are also established; however, seedlings are often transplanted to people's yards.

Six cottonwood trees were also planted in 1906 amongst the spruce, but became crowded and were cut out when the cottonwoods were about 25 feet tall.

The entire plantation is on an east-facing slope protected from the northwest wind. This seems to be a critical factor since trees exposed to the winds show signs of desiccation -- dead red needles and grow

so slowly or have the shape of a bush. Mr. Gronholdt states that in contrast, the plantation sheltered from the direct assault by the northwest wind, a tree planted on a spot at the town of Unga also in 1906 is stunted and only 10 feet tall. He planted a spruce from Kodiak on the northwest side of his house. It grew slowly for several years, then ceased height growth, and the needles turned brown. The tree was transplanted to the east side of the house in 1968 in the lee of the wind where it now flourishes, looks healthy and has grown to be nine feet tall.

Popof Island in the Shumagin Islands boasts 141 spruce trees, 7 cottonwoods, 1 hemlock, 1 aspen, 2 birch and another tree similar to a cottonwood but sends out runners from which shoots grow. Many of the above-included trees were planted since 1940 and were dug up on Kodiak Island and on the Kenai Peninsula. All were about two feet tall at planting and now are between 14 and 24 feet tall, and most are in the lee of the wind.

Plantations have also been established on Unga Island at Squaw Harbor and Unga. The 15 spruce and one probable cottonwood are presently up to 30 feet tall, but the planting date and origin of the tree is unknown.

At Unga Village, about 20 spruce from Kodiak Island were planted since 1945; several have grown to 20 foot heights. Several other outer islands have a few spruce planted on them.

The people of the Shumagins are proud of their past tree planting efforts and the success of the trees, and they plan to plant more trees in the coming years.

Six Sitka spruce from Kodiak Island were planted at the Alaska Department of Fish and Game in the spring of 1962 by Ken Gilpen. They were two feet tall when planted and had grown to 5-5 1/2 feet (one tree is 6 feet tall), by Fall 1973. Five trees are still alive. (Glenn Davenport, 1973, telephone conversation.)

Evidently, a tree planting program had been conducted by the military on Amchitka Island also, and one live tree was observed near the old Officer's Club in 1969 as reported by Al Feulner, and Lyman Woodman in a personal communication. Mr. Vern Byrd of the U.S. Fish and Wildlife Service reports that both trees at the old Officer's Club were alive in 1970 as well as one or two others on the island, but he could not pinpoint their exact position.

Tom O'malia stationed for several years at Cold Bay with the Federal Aviation Administration reports spruce (probably Sitka) planted by the military in 1943. Most were planted in exposed area and are

about four feet tall except for one tree which was planted in a gravel pit. It is considerably taller. All trees have very slow growth rates.

Bob Jones of the U.S. Fish and Wildlife Service believes that the trees were transplanted from Kodiak Island. He reported that some trees are 8 to 12 feet tall with diameters up to a five inch maximum. None of the trees produce cones; therefore, there is no reproduction of seedlings.

It appears that trees can grow and reproduce on the Aleutian Chain. From the comments offered in personal communications (Jones and Gronholdt), it appears that a well chosen site where the soil or edaphic factors will allow tree growth and shelter from the northwest wind which both desiccates the plants and carriers abrasive volcanic ash are prime considerations in successfully establishing trees on the Aleutian Islands where summer temperatures will allow. Control of animals which could graze or otherwise damage the trees is also important as is choosing the correct species to transplant and select it from the best genetic stock to assure success.

Sitka spruce appears to be the most successful conifer transplant and interior white spruce and other exotic species like Douglas fir appear to die rapidly. More research, of course, is necessary to determine the causes of tree failure -- one, of course, could be lack of care

in planting the tree which could cause root damage and drying out. The major reason probably is insufficient summer warmth. Several hardwood types appear to live at least on the Shumagin Islands. Temperatures could be a critical factor along with the wind which would determine whether or not trees can survive. The Shumagins have an average summer month temperature only slightly warmer than Cold Bay, but these three or four degrees could be a limiting factor affecting tree survival and equally important, cone and viable seed production.

The present range of the coastal hemlock, Sitka spruce ecosystem and interior upland white spruce, birch, aspen, poplar ecosystem could be slowly expanding their ranges southwestward out the Alaska Peninsula and Aleutian Chain. Climatic and edaphic conditions obviously allow tree growth, and man is accelerating the natural, slow reforestation process.

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